Space Weather Technical Forecast

Issued on Thursday, 29 June 2023 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Active electron fleunce. Moderate solar activity likely. Slight chance of G1/Minor Storm on 01 July.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low, with several C-class flares over the 24 hour period. AR3354 near north centre disc has continued its growth over the past 24 hours and is now a very large region, with a weak delta spot. AR3340 has a history of moderate solar activity, but is becoming difficult to assess as it approaches the northwest limb. The other regions remained small or simple, with no significant change.
A CME which left the northeast of the Sun late on 27 June from the vicinity of AR3354 has been analysed and is forecast to glance the Earth on 01 July, but with low confidence. No further Earth directed CMEs were observed in the period.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, was slightly elevated or occasionally elevated with wind speeds between 430 and 520 km/s. Density was mostly below average, but increased after 29/0500 UTC to become average or slightly above. The total magnetic field strength was weak, at 7 nT or below, with the north-south component also varying weakly, although it has been more southward directed in recent hours. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at background levels. High energy electron flux (greater than 2MeV), has been reaching High levels at times, with a peak value of 3510pfu at 28/1555 UTC. The associated 24-hour fluence rose during the period, exceeding the Active threshold at 28/1800 UTC, with a peak of 1.15e8 integrated pfu at 29/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares, mainly from AR3354.

Solar Wind / Geomagnetic Activity: A CME which left the northeast quadrant of the Sun on 27 June may glance the Earth early on 01 July, but this is low confidence. Otherwise in the absence of CME activity, the current slightly elevated solar wind speeds are expected to slowly decline to near ambient levels.
Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a slight chance of G1/Minor Storms, mainly on 01 July, due to the potential CME glance.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is most likely to remain at background levels but with a slight chance of reaching the S1/Minor Storm level, mainly due to AR3354. High energy electron flux (greater than 2MeV) is likely to show a declining trend. Active (1e8 integrated pfu) electron fluence is also expected to decline, although the potential CME glance may give a sharper decrease, should it occur.

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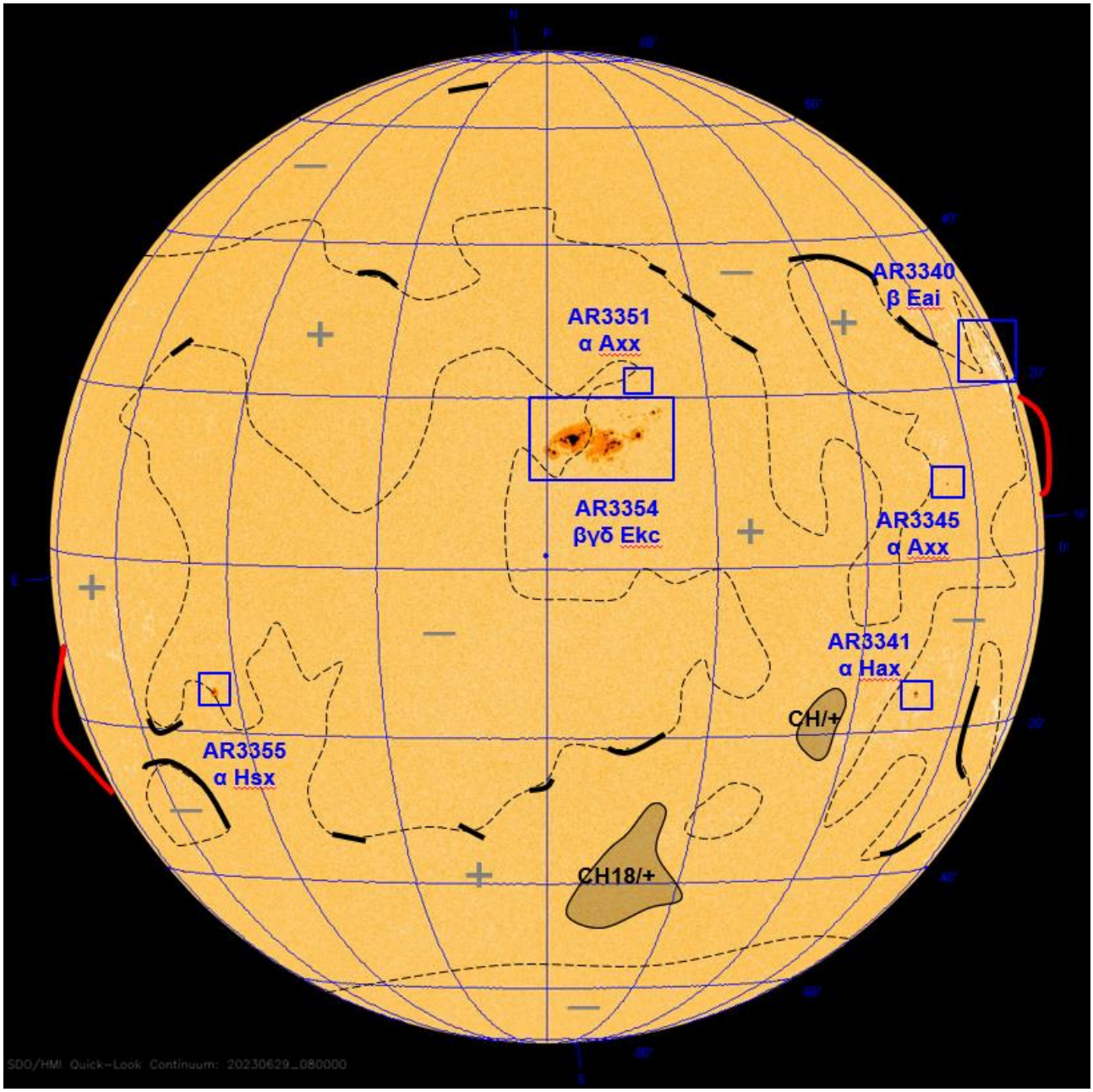
Figure 1. Solar Analysis Valid 29/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the northeast quadrant of the Sun on 27 June may glance the Earth early on 01 July, but this is low confidence, with a range of arrivals between 30 June and 02 July possible.

Otherwise in the absence of CME activity, the current slightly elevated solar wind speeds are expected to slowly decline to near ambient levels, with only limited influence from coronal hole 18. This appears to be a weakening feature with only a slight enhancement noted during the previous rotation. No further coronal holes are discernible on current satellite imagery. Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a slight chance of G1/Minor Storms, mainly on 01 July, due to the potential CME glance.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
28/0336	Partial	Filament eruption	NE quadrant, near AR3354	600 km/s	01/0600 UTC	Glancing impact possibel but low confidence.

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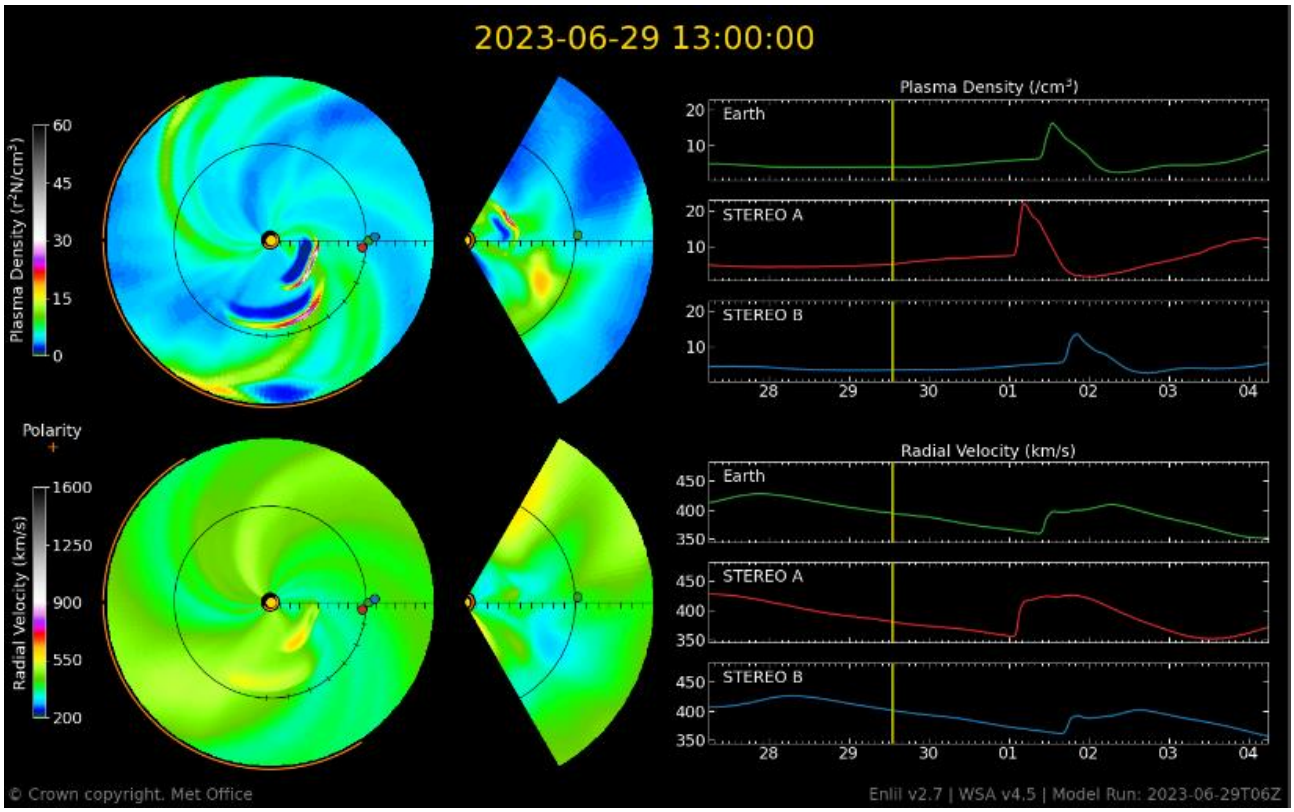
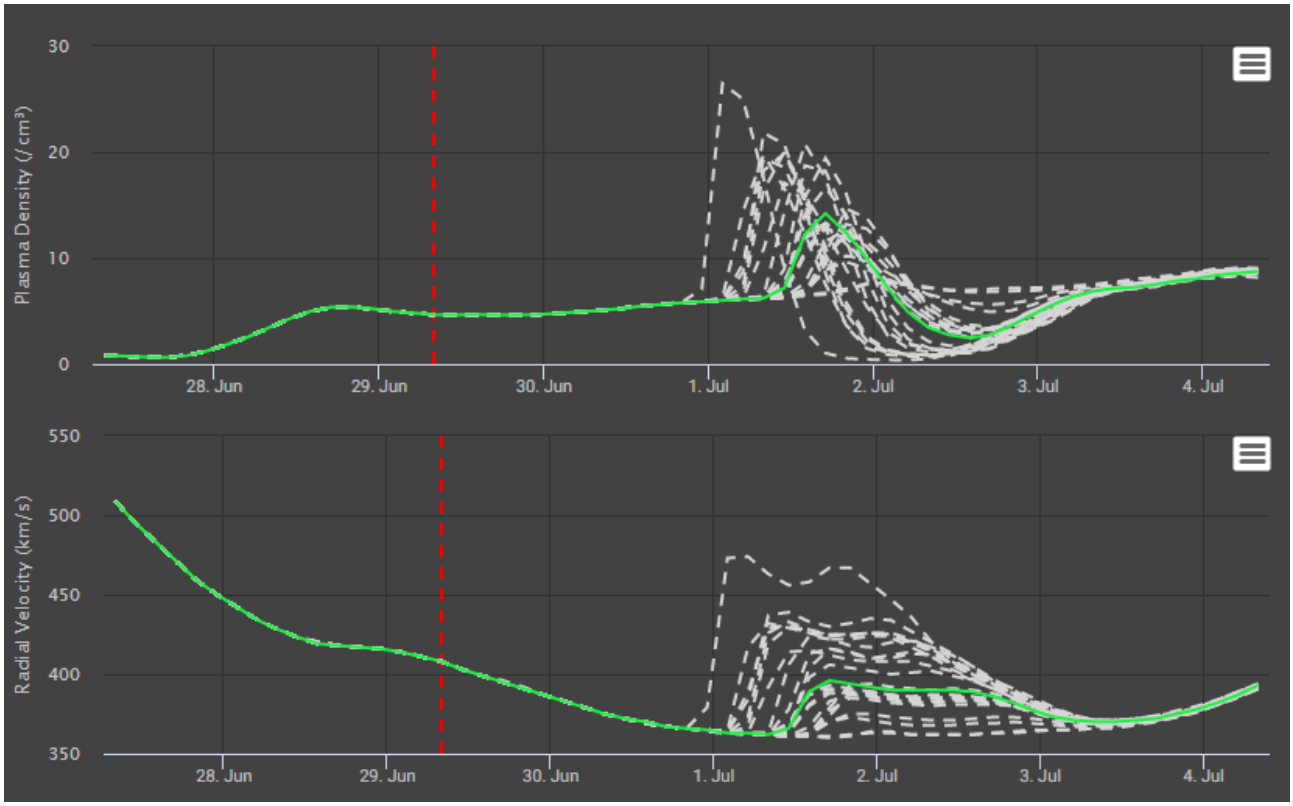
Figure 2: MOSWOC Enlil and ensemble, showing a possible CME glancing blow on 01 July.





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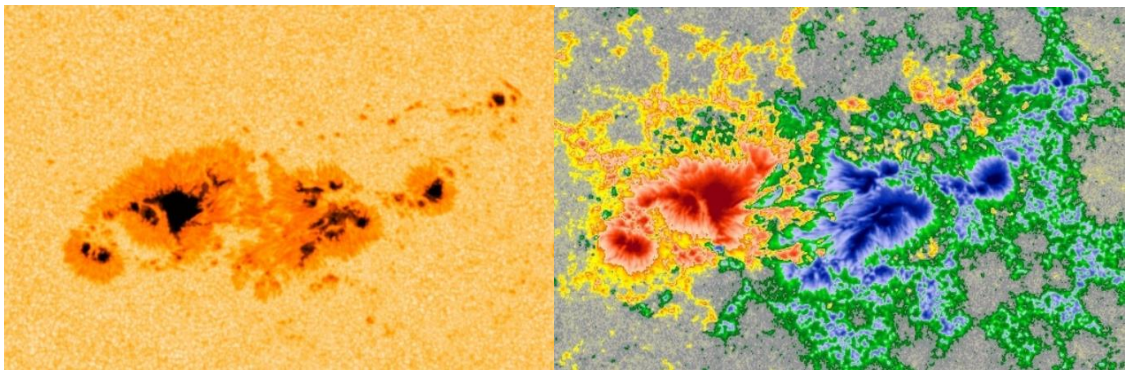
Radio Blackouts - X-Ray Flares:
Solar activity has been Low in the last 24 hours. The disc is dominated by the rapidly evolving AR3354 (Ekc/Beta-Gamma-Delta), near north centre disc. It continues to grow and still retains a weak delta spot. Although it has shown little activity so far, the magnetic flux associated with this region appears to be sufficient for an X-flare. AR3340 (Eai/Beta) near the northwest limb also has a history of M-flares, but is becoming difficult to assess as it approaches the limb. As such, the current classification will be maintained as it rotates off. The remaining regions on the disc are generally small and simple at present.

Low to Moderate solar activity is expected to continue through the forecast period, with a slight chance of X-class flares, these most likely from AR3354. A slight decrease in flare probability is forecast later in the period, as AR3340 rotates off the disc.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	60	60	50	50
Very Active	R3 to R5 X Class	No	15	15	10	10

Figure 3: SDO intensitygram and magnetogram showing AR3354, which has developed into a large and fairly complex region.



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at background levels and is most likely to remain so throughout the period. However there is a slight chance of reaching the S1/Minor Storm threshold, mainly due to AR3354 and AR3340. AR3354 in particular has developed into a large and complex region, and is now transiting across the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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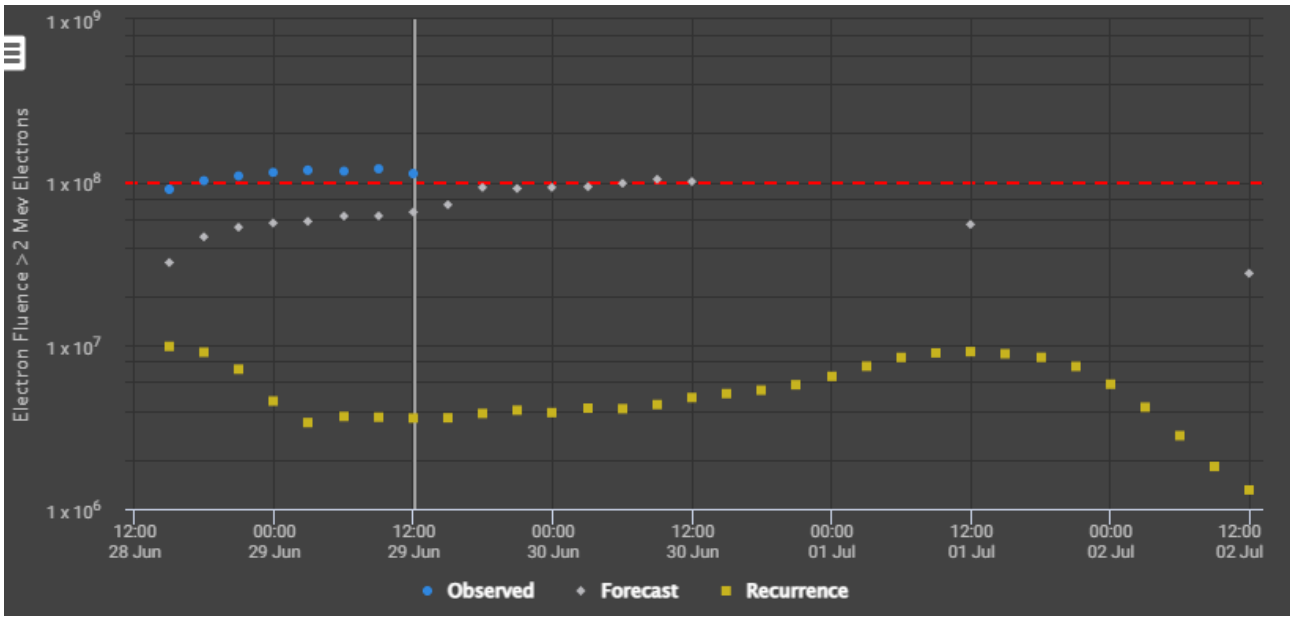
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) has oscillated between moderate and high levels through the last 48 hours, likely due to an increase in flux caused by the CME arrival over the weekend. This pattern is forecast to continue over the next few days, but with a declining trend most likely. However, if the low confidence CME glance occurs on 01 July, this may cause a sharp decrease in flux levels.

The electron fluence is currently above the Active threshold (1e8 integrated pfu). This is expected to decline through the next few days, although again should we see the aforementioned CME at Earth then a more rapid decline is possible. MOSWOC REFM is also suggesting a decline in the coming days and this trend seems reasonable.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	70	50	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM showing a declining trend in electron fluence.



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